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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/735,706	12/16/2003	Karl Schreiber	2560-0415	3451

7590 05/25/2006

DAVIDSON BERQUIST KLIMA & JACKSON LLP
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EXAMINER	
HEINRICH, SAMUEL M	
ART UNIT	**PAPER NUMBER**
1725	

OIPE
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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)
	10/735,706	SCHREIBER ET AL.
	Examiner	Art Unit
	Samuel M. Heinrich	1725

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 March 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-12 and 21-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-12 and 21-35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 4-12, and 21-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 6,223,976 to Clement et al in view of Applicant's Admitted Prior Art (AAPA) and in view of Metals Handbook. Clement discloses the known process of laser joining, with or without filler material, of titanium aluminides. AAPA comprises descriptions in the specification, such as Background of the Invention, and comprises the Information Disclosure Statements which comprise documents pertaining to a variety of known joining processes for materials such as titanium aluminide. Metals Handbook describes (page 1064, column 1, last paragraph) "advantage laser brazing

offers ... is its ability to produce a brazed connection locally without heating the entire part or component" and describes "advantage is the high degree of control of the thermal energy of laser beams, including intensity, spot size, duration, and ability to be located or positioned precisely." The use of a laser joining process for joining titanium aluminide aligned to form a braze joint and with a filler deposited in the braze joint would have been obvious at the time applicant's invention was made to a person having ordinary skill in the art because the joint layup is known in the art and because the laser joining has well known properties such as having a small heat affected zone. Applicant has recited numerous dependent limitations which read like a book description of joining processes. There are numerous well known books and handbooks which describe all of the well known joining process limitations set forth in the instant dependent claims. The use of well known joining process limitations such as workpiece shape as a sheet, braze gaps, butt joints, protective gas, temperature and pressure, braze construction, and backing bars would have been obvious at the time applicant's invention was made to a person having ordinary skill in the art because the teachings are readily available to all students of joining.

Claims 1-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP61095769 in view of EP0904881A1 and in view of Applicant's Admitted Prior Art (AAPA). JP61095769 describes laser brazing of a turbine blade. EP0904881A1 describes diffusion brazing methods for titanium aluminide parts. AAPA describes well known titanium aluminide turbine blades. Metals Handbook describes (page 1064, column 1, last paragraph) "advantage laser brazing offers ... is its ability to produce a

brazed connection locally without heating the entire part or component" and describes "advantage is the high degree of control of the thermal energy of laser beams, including intensity, spot size, duration, and ability to be located or positioned precisely." The use of a laser joining process for joining titanium aluminide aligned to form a braze joint and with a filler deposited in the braze joint would have been obvious at the time applicant's invention was made to a person having ordinary skill in the art because the joint layup is known in the art and because the laser joining has well known properties such as having a small heat affected zone. The use of the laser brazing of well known parts made of well known titanium aluminide would have been obvious at the time applicant's invention was made to a person having ordinary skill in the art because the laser is well known to provide a low heat affected zone and therefor maintains workpiece material properties. Applicant has recited numerous dependent limitations which read like a book description of joining processes. There are numerous well known books and handbooks, such as the Metals Handbook, which describe all of the well known joining process limitations set forth in the instant dependent claims. The use of well known joining process limitations such as workpiece shape as a sheet, braze gaps, butt joints, protective gas, temperature and pressure, braze construction, and backing bars would have been obvious at the time applicant's invention was made to a person having ordinary skill in the art because the teachings are readily available to all students of joining.

Response to Arguments

Applicant's arguments with respect to claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel M. Heinrich whose telephone number is 571-272-1175. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, P. Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Samuel M. Heinrich

Samuel M Heinrich
Primary Examiner
Art Unit 1725

SMH

Notice of References Cited	Application/Control No. 10/735,706	Applicant(s)/Patent Under Reexamination SCHREIBER ET AL.	
	Examiner Samuel M. Heinrich	Art Unit 1725	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-			
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Metals Handbook Ninth Edition, Volume 6, Welding, Brazing, and Soldering, pp 1064-1066, copyright 1983.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Metals Handbook Ninth Edition

Volume 6 Welding, Brazing, and Soldering

Prepared under the direction of the ASM Handbook Committee

Planned, prepared, organized, and reviewed by the ASM Joining Division Council

Coordinator

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AMERICAN SOCIETY FOR METALS
METALS PARK, OHIO 44073

First printing, August 1983

Metals Handbook is a collective effort involving thousands of technical specialists. It brings together in one book a wealth of information from world-wide sources to help scientists, engineers, and technicians solve current and long-range problems.

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Laser Brazing

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LASER BRAZING is a metals-joining process that uses the thermal energy developed by laser beams to perform localized brazing on thin-walled precision parts. Because of the higher costs of brazing with lasers, the method should be considered only when conventional brazing methods are not adequate. A list of "problem" applications that are candidates for laser brazing appear below. These metals-joining applications frequently are difficult, if not impossible, to do by ordinary brazing methods, but have been accomplished with laser brazing:

- Miniature precision parts that require minimal heat input during joining operations to maintain dimensional tolerances
- Thin base metals, 0.004 in. and less, that tend to become eroded and sometimes perforated during brazing operations using filler metals or fluxes
- Joints on assemblies containing heat-sensitive materials or parts that cannot be removed during joining operations
- Brazed joints near glass-to-metal seals, adhesively bonded joints, or other thermally sensitive connections
- Connections inside evacuated or pressurized vessels or containers (e.g., within sealed glass vacuum tubes)

The main advantage laser brazing offers over more conventional brazing processes is its ability to produce a brazed connection locally without heating the entire part or component to the flow point of the brazing filler metal (Ref 1). Another advantage is the high degree of control of the thermal energy of laser beams, including intensity, spot size, duration, and ability to be located or positioned precisely. Also, because a laser beam is capable of being transmitted through solids that are transparent to its wavelength, brazing can be accomplished within hermetically sealed vacuum or high-pressure atmosphere enclosures.

While other laser brazing modes are possible and are likely avenues of future development, most laser brazing is confined to line-contact types of joints where fillets are made to bridge across the intersection of two surfaces, or of a surface and an edge. Infrequently, a bead is made to connect two abutting edges (butt joint). Because the flow of the filler metal is confined to the region heated by the laser beam (generally a circular spot), a seam is brazed by producing a series of overlapping spots.

Laser Brazing Process

In most applications, the laser beam is aimed directly at the preplaced filler metal in the joint, and the weld is executed (Ref 2). The technique of heating the region of the joint adjacent to the filler metal is not the dominant mode of brazing with lasers. Although such an approach does work, it offers little advantage for using lasers over conventional brazing techniques. Relatively extensive areas of the part must be heated, and the time to reach the flow temperature of the filler metal is relatively long because the thermal coupling efficiency of lasers is poor. Also, distortion from attempts to locally heat a part to the brazing temperature using an intensive heat source, while taking care not to melt the surface, can cause as much distortion as a fusion weld (and sometimes more), eliminating one of the advantages of choosing a laser brazing process.

Generally, laser brazing involves positioning the workpiece under the fixed laser beam. While it is possible to position laser beams upon a fixed part or workpiece, it is simply more convenient and requires less costly equipment to fix the laser and move the workpiece, which is usually very light and small. Both continuous wave (cw) CO_2 and pulsed lasers can be used, but solid-state pulsed lasers, such as neodymium-doped yttrium-aluminum-garnet (YAG) pulsed lasers, appear to be more adaptable to the progressive overlapping spot mode of brazing. Their shorter wavelength also seems to couple more efficiently to brazing alloys of high-conductivity and high-reflectivity metals, such as copper, silver, and aluminum.

The workpiece is positioned above the focal point of the laser beam to obtain the proper balance between energy density (a somewhat diffused thermal pattern is desired for brazing) and beam width (at its point of intersection with the surface to be brazed). In lasers that have an adjustable beam output mode (i.e., transverse electromagnetic mode, or TEM), a favorable pattern for brazing has been the TEM_{01} mode, which provides a toroidally shaped thermal energy pattern. Brazing is accomplished with one pulse per spot, with considerable overlap (more than 50%) from one spot to the next.

Brazing filler metal is preplaced in the joint, either as a powdered alloy or a shim sandwiched between the members. The powdered alloy is easier to use and handle, and most alloys remain in place during the series of laser pulses. However, increased beam power levels needed for filler metals of high reflectivity or thermal conductivity may require the filler metal to be used in the form of foil or shims sandwiched between the joint members to retain it during application of the necessarily higher beam power levels. Attempts to use cements or binders to hold the powdered alloys in the joint during laser brazing have been unsuccessful due to contamination of the joint and the surrounding region.

Table 1 Typical laser brazing conditions for T-fillet joints

Joint members: Side A	Joint members: Side B	Filler-metal classification and form	Laser characteristics: Pulse energy, J	Beam spot diam, in.	Pulse width, s	Pulse peak power, W
Type 304 stainless steel (0.005 in.)	Same	BAg-8 powder	7.3	0.044	0.010	860
Type 302 stainless steel (0.001 in.)	Same	BAg-1 powder	0.2	0.012	0.008	30
Type 316 stainless steel (0.005 in.)	Same	BNi-2 powder	5.2	0.044	0.010	610
Monel 400 (0.001 in.)	Type 316 stainless steel (0.004 in.)	BAg-6 powder	4.5	0.028	0.010	520
Copper (0.001 in.)	Nickel 200 (0.001 in.)	BAg-18 powder	14.7	0.044	0.010	1730
Nickel 200 (0.001 in.)	Iron (0.001 in.)	BCu-1 foil	6.8	0.032	0.010	800

Note: For filler-metal classification information, see AWS A5.8-76, "Specification for Brazing Filler Metal," American Welding Society, 1976. Powders used were −325 mesh. Fluoride-based silver brazing flux used with all filler metals except BNi-2 and BCu-1, which were 0.002-in.-thick foils and were brazed without flux. Protective argon shielding gas used for all brazed joints. All joints were brazed with neodymium YAG pulsed laser with 80-J maximum pulse energy and 50-W maximum output power, equipped with 100-mm focal length lens.

Adequate atmospheric protection is required for all laser brazing, whether or not a flux is used, even if precautions are taken to keep the joint region free of contaminants. Depending on the composition of the materials, the purity of the filler alloy, and other variables, joints may be brazed without a flux, but a protective atmosphere (argon shielding or vacuum) should always be used. When a flux is used, it may be mixed with the powder filler alloy into a paste using water or alcohol and applied to the joint. The mixture must be thoroughly dried before attempting to braze.

Best results have been obtained by firing the laser beam directly over the joint containing the preplaced filler, with the beam axis coinciding with the joint axis. Where both joint members are of equal thickness, the joint should be oriented so that the beam bisects the angle between the members. For example, for a 90° T-fillet joint between materials of equal thickness and conductivity, the joint should be tilted so that the beam is positioned 45° from both members and normal to the longitudinal axis of the joint. For members of different thicknesses, the joint should be tilted so that the laser beam is directed toward the thicker or more conductive member. The objective is to obtain the same thermal energy input in both members and thereby obtain a uniformly contoured fillet braze profile.

Table 1 lists typical conditions for laser brazing fillet joints between various metals and alloys. Actual values for specific laser installations can be expected to vary from the given values because of differences in pulse duration and pulse shape from laser to laser and variations in thermal energy coupling effects with differing surface finishes of the material and compositions of the brazing filler metals. It is important to note that base-metal thicknesses, as well as thermal conductivity and optical reflectivity of both the base metal and filler metal, influence the level of laser pulse power required to melt the brazing alloy and heat the base metal sufficiently for flow across the joint to occur.

Laser Brazing Versus Conventional Brazing

In most, if not all, other brazing processes, the filler metal is distributed between the closely fitting surfaces of the joint by capillary action. Because the flow of the filler metal is limited to the region heated by the laser beam in laser brazing, capillary action plays a much less dominant role. The area heated by the laser beam is often less than a millimeter in width.

Conventional brazing frequently is used in lap seams or to make joints between two closely fitting parallel surfaces, as in socket joints or sleeve connections, where preplaced or manually added filler metal fed from an adjacent location flows during the heating process by capillary action. While lap seams conceivably could be brazed using a laser in a rastering (scanning) mode, conventional brazing would be much simpler and less costly.

Limitations of Laser Brazing

Laser brazing generally should be reserved for precision jobs that require the strength of a brazed joint but for some reason cannot tolerate the heat, distortion, or other consequences of more conventional techniques. Another fundamental consideration is the availability of a laser of adequate power and the availability of accessory workpiece-positioning equipment. Currently, metalworking laser installations are expensive in comparison with the costs of conventional brazing facilities. In time, and with wider use, the costs of metalworking laser systems will be reduced. However, laser brazing will never replace conventional brazing techniques, except for specific applications such as thin-walled precision parts that must be produced in large quantities. For such applications, lasers would be cost-effective competitors of conventional brazing processes for production joining of large numbers of precision parts that facilitate computer-controlled automation.

Studies of laser brazing have revealed a number of effects of the very rapid rate of solidification associated with pulsed lasers that are not encountered in conventional brazing. Some of these are advantageous, while others can be detrimental. For example, laser brazed deposits in some alloys have exhibited unusually high levels of as-deposited hardness and strength. The strength of laser brazed joints has, in some cases, exceeded that of fusion welds made in the same base materials. Table 2 compares microhardnesses of conventionally brazed and laser brazed deposits.

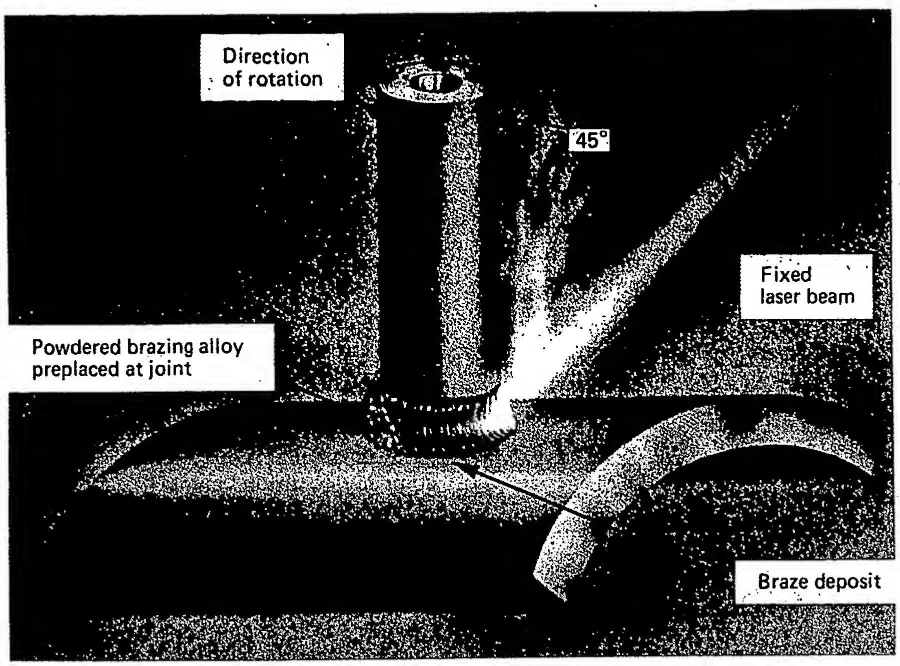
At the same time, the rapid rate of solidification characteristic of laser-melted deposits has led to levels of brittleness that would be unsuitable in joints for many applications made with some fillers (the BNi series, for example). This can be overcome by varying laser parameters, such as use of greater beam width, longer pulse

Table 2 Comparative microhardness of conventionally brazed and laser brazed deposits

AWS brazing filler-metal classification	Deposit microhardness(a), DPH: Oxyfuel gas brazed(b)	Laser brazed(c)	Hardness increase ratio
BAg-1(d)	120(e)	232(e)	1.93
BAg-6(d)	106(e)	176(e)	1.66
BAg-8(d)	102(e)	200(e)	1.96
BAg-18(d)	123(e)	148(e)	1.20
BNi-2(d)	692(g)	920(g)	1.33
BCu-1(f)	61(e)	72(e)	1.18
BAu-4(d)	268(e)	340(e)	1.27
BAlSi-2(f)	53(e)	62(e)	1.17

(a) Averages of five determinations. (b) Brazing filler metal placed on surface of 1020 carbon steel strip (0.062 in. thick); surface protected from atmospheric contamination by argon shield. Underside of steel strip heated by oxyfuel gas torch until flow of brazing filler metal occurred. (c) Determinations made on T-joint fillet brazed deposits. (d) Powder (−325 mesh). (e) With flux. (f) Foil. (g) Without flux

Fig. 1 Laser brazing of capillary tubing to pressure sensor fitting



duration, and increased braze spot overlap, in alloys that are hard and experience a further increase in hardness when solidified rapidly. The same considerations also apply when brazing base materials that are hardenable under conditions of rapid quench.

The effects of high levels of solidification stress combined with high deposit hardness can cause a liquid-metal-embrittlement type of cracking with some brazing filler metals in some alloys in a highly cold worked condition. These isolated occurrences are not unexpected with such radically different modes and rates of heating and solidification, but they do indicate the wisdom of conducting a well-planned and comprehensive series of tests to determine the appropriateness of use before committing to any new joining procedure like the laser brazing process.

Example 1. Laser Brazing Capillary Tubing to a Pressure Sensor Fitting. A miniature pressure sensor assembly required a strong, pressure-tight (several thousand psi) joint between 70Cu-30Ni capillary tubing, with an outside diameter of 0.007 in. and a wall thickness of 0.002 in., and a type 316 stainless steel fitting having a wall thickness of 0.005 in. Previous attempts by conventional brazing techniques invariably resulted in flow of the brazing alloy into the 0.003-in.-diam bore of the capillary tubing and the closing of it. Attempts to fusion weld the copper-nickel to stainless steel were similarly unsuccessful. The parts were successfully laser brazed using the procedure described below:

- *Laser characteristics*: Neodymium YAG 50-W pulsed laser; 4-in. focal length lens; TEM_{01} mode; pulse interval, 3 s; laser pulse energy, 0.87 J; measured beam spot diameter at workpiece, 0.036 in.; total pulse width, 6 ms; effective pulse width, 5.1 ms; peak pulse power, 0.2 kW (energy density = 1.4×10^2 J/cm^2; power density = 2.7×10^4 W/cm^2
- *Flux*: Standard fluoride-based silver brazing flux mixed with powdered brazing filler metal in a flux-to-filler-metal proportion of 1-to-20 by volume
- *Filler metal*: Prealloyed powdered −325 mesh BAg-1 class (silver-cadmium-copper-zinc) filler and flux mixture (water added to make paste consistency) was preplaced in joint region and a controlled volume provided in the joint by drawing a 0.04-in.-diam metering rod through the mixture, allowing the surface of the rod to run along the sides of the joint members. The resulting meniscus-shaped volume of the flux and filler mixture was dried thoroughly under an infrared heat lamp before brazing.
- *Shielding gas*: The entire joint region was blanketed with pure argon using a shaped porous bronze gas-distribution shielding fixture with a hole to allow access for the laser beam.
- *Laser/joint configuration*: The length of capillary tubing was first assembled to the stainless steel fitting by inserting the end of the tubing into a hole drilled through the fitting. This positioned the tubing in the desired location and retained it in alignment during brazing. As shown in Fig. 1, the entire joint assembly was rotated incrementally with each laser pulse, allowing about an 80% overlap of each previously brazed spot. The laser head was fixed above the rotation fixture holding the part. A series of tacks equally spaced around the periphery of the joint were first made, followed by a full rotation of the joint for the brazing cycle.

REFERENCES

1. *Brazing Manual*, 3rd ed., American Welding Society, Miami, 1976
2. Witherell, C.E. and Ramos, T.J., Laser Brazing, *Welding Journal*, Vol 59 (No. 10), Research Supplement 267s-277s, Oct 1980

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